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TOWARDS THE MODEL OF SELF-TUNIG BUSINESS PROCESS MANAGEMENT

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Abstract

The interest in Business process Management (BPM) has flourished in the last decade as the adverse business conditions forced corporations to improve efficiency and effectiveness in daily operations. Though BPM can deliver significant business value, in practice it revealed challenges that prevented businesses from successful adoption. The modelling process has four distinct phases which leads to a lengthy implementation and often renders the processes too constrained for real life situations. This paper proposes a bottom-up approach based on actual daily activities logged by underlying monitoring infrastructure. If a number of activities form a repeatable sequence, they can be declared as a business process. A process may be identified by a single activity of the same type and source and destination in the Organizational Breakdown structure. Different repetitions of the same process can be compared and variations recorded. If the same variation is detected multiple times, the process definition can easily self-modify to become the new standard.

Keywords: business process model, business process monitoring, business process self-tuning

1. INTRODUCTION

Technology advances in the last few decades changed profoundly the way enterprises do business. Global corporate visibility, technology tools to improve marketing and acquiring new customers introduced competitiveness at unprecedented level. Market volatility forced companies even further in search of improvements and cost control leading them into analysis of internal procedures and processes. Old ways of doing business needed to be adapted to new technologies. This led to wide effort in design of workflow management software tools in the nineties. Oriented mostly to manufacturing processes, professionals searched to optimize seconds in manufacturing because this led to high gains in yearly production. Manufacturing processes are well defined and easily measured, so analysis was fairly straightforward and changes fluently implemented. About the end of the century, management realized that improvements in manufacturing processes have only a limited reach and that processes outside the manufacturing plant need a redesign and optimization. Those processes, however, were not so well designed, they relied on individual experience and C-level managerial capability to organize effectively business processes inside their business units. This led to process micromanagement and lack of transparency across business units which later became one of the main challenges in corporate processes optimization. Workflow management efforts were broadened and we started talking of Business Process Management (BPM) whose benefits were hugely appealing but implementation revealed challenges that proved difficult to overcome.

Although the benefits of process modelling were undoubtedly present, financial gains were not easily quantified, which together with the amount of corporate effort needed to model and actualize the changes, made corporate management reluctant to invest in modelling initiatives. Indulska & All (2009) led a study of perceived benefits from implementing business process modelling and identified process improvement, inter-process communication, process performance measurement, problem discovery and cost reduction as most important.

Intangible financial benefits of process modelling in the enterprise do not justify management reluctance to encourage the necessary changes and invest time and funding, because the companies that implemented BPM procedures perform consistently better that the ones that didn't. Castelina (Jan 2015) found that the enterprises that use BPM tools are 2.7 times as likely to be able to quickly tailor business systems to react to business change than the ones who don't use BPM. A later analysis (Castelina, Oct 2015) based on 118 respondents showed significant enhancements in variety of performance metrics in enterprises with implemented BPM tools.

The implementation of Business Process Management framework requires a change of employee's approach to everyday work. Most people are not used to thinking in process terms (Lyke-Ho-Gland, 2017).

APQC (2106) conducted a survey of 231 businesses to understand better the challenges and priorities of process management. The top ones were: moving from a function-based to process-thinking culture, defining and using process measures and Engaging leadership in process management.

Capgemini research study (2017) identifies five main barriers to BPM implementation: functional silo culture, fragmented budget, perception of BPM as an IT item, Resistance to BPM from IT staff who have responsibility for existing systems and lack of change readiness or willingness.

To gain insights into disappointing performance of information systems in BPM implementation, Mutschler & All (2007) conducted three empirical studies. They found five main problem areas: process evolution, hard-coded process logic, complex software customizing, inadequate business functions and missing process information. The study showed that many problems arise from the evolution of the business process and its variability. That is logical, as a business process is a live essence that should adapt constantly to new business conditions. But this forces constant changes in software which becomes complex task especially with hard-coded process logic which was predominant method of software development during last decades. Existing software solutions lack the possibilities to customize process logic at sufficiently flexible and detailed level.

There is a notable uncertainty among practitioners about how to create process models that analysts and business professionals can easily analyse and understand (Mendling & All, 2010). Existing frameworks provide insight into main process categories but remain too abstract to be directly applicable in practice.

Contemporary workflow management systems need completely specified design to enact a workflow managed process (Van der Aalst & Van Dongen, 2002). The design is a complex, time-consuming process and there are typically discrepancies between actual workflow processes and the processes perceived by the management.

Today's workflow management systems enforce unnecessary constraints on the process logic (Van der Aalst & all, 2003) which was often mentioned as one of the main challenges in the adoption of BPM tools.

This paper proposes business workflow discovery based on actual flow of documents and information across different corporate departments which becomes the source for business process model and post-optimization monitoring.

2. METHODOLOGY

In view of a large scale software integration across multiple business units, the author felt it was sensible to test in a real life business situation how often and to what extent those challenges influence the flow of a business process and what steps could be taken to compensate for such events. In the next section, a real life business process is described, the flow of events around vehicle defect repair in an Internal Workshop Repair Unit. The process was selected for its straightforwardness and relative simplicity. It is part of a larger chain of processes across Transport Management and Preventive Maintenance systems and different dislocated business units, but those implications were not considered here for clarity. Observed behaviour and found discrepancies from standardized procedures are explained next. A solution is proposed next based on a modified model of Multidimensional Preemptive Coordination, which in this case serves as a monitoring infrastructure to detect deflection from a standard business process and recommend a change or improvement to the modelled process.

The process observation was done at the location of municipal largest road maintenance company during December 2016. The company has six business units and another four that are territorially organized. A total of 977 vehicles and machinery are scattered across all the business units but the majority are organized in the Machinery Business Unit. Such a number of assets justifies the existence of an Internal Repair Workshop as a department. Internal Repair Workshop executed 3472 repairs in the year 2014, 3398 repairs in year 2015 and 3223 in year 2016. The company does not have BPM software tools implemented, but they are ISO-9001 certified, so that the processes are modelled and well documented. As the assets are of great value to the company, costs are meticulously tracked not only by asset, but also by business unit, operator and project. Each defect repair generates a Workshop Order where a number of records are kept: repair hours by type, spare parts, auxiliary material issued from the local warehouse, fuel etc.

A simplified model of the Internal Workshop Order (IWO) process is shown in Figure 1. When the operator or driver detects a defect he comes to the Machinery Business Unit (MBU) Supervisor who issues a Request with the operators description of the malfunction. This step is marked S1 for its later significance. The Workshop foreman opens the IWO and initiates an inspection. The inspection will show whether the defect can be addressed internally or the asset has to be sent to an external repair workshop. In that case, the asset is steered to external destination and a Request is issued to the Procurement department to follow with an Order. If the repair is possible internally, the necessary team of mechanics is assigned and a Request for spare parts and auxiliary material is initiated. The warehouse employee issues the material to the team, repair is performed and final inspection done. If the inspection is positive, the asset is released, the foreman verifies and records working hours, spare parts and auxiliary material used, prepares all the paper documents (the electronic copies are already online) and takes it to the MBU supervisor. The supervisor validates that all the documents are ready for invoicing and releases it to the proper employees. This step is marked S2. The administrator prepares the IWO for invoicing and at the end of the month an internal invoice is issued to the respective business unit.

3. RESULTS

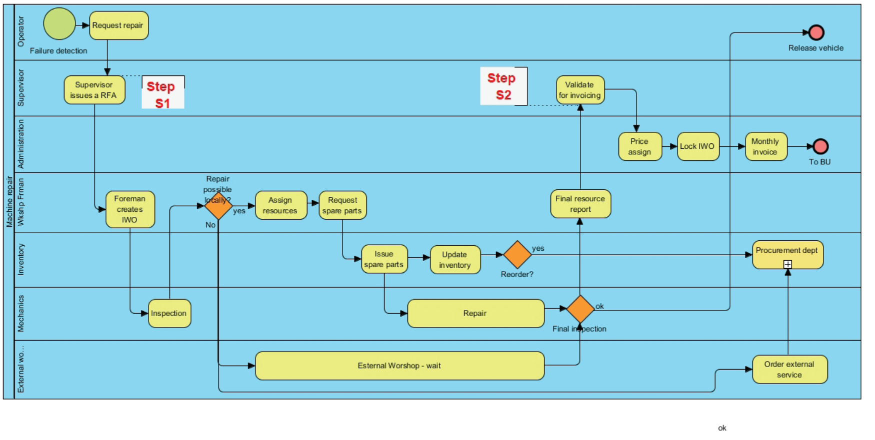

Figure 1 Internal Work Order process

Table 1

Number of defects per asset

once	twice	3 times	4 times	5 times	6 times
64	46	31	14	13	15

Table 2

Number of days per IWO

1 day	2 days	3 days	4 days	5 days	>5 days
245	21	5	2	3	12

In December 2016 there were 288 Internal Workshop Orders observed. A total of 183 assets, both vehicles and machines were repaired. The assets spent 1176 days in the workshop and a total of 1543 effective repair hours were executed. Each IWO took on average 4.08333 days to finish and included 5.35764 effective hours of work. Some assets had defects more than once and on average, an asset spent 6.42622 days in the workshop and was charged with 5.35764 effective hours of work. The distribution of number of defects per asset is presented in Table 1. The distribution of IWO duration in the period is shown in Table 2.

For the purpose of this discussion, the most important result is that out of 288 Internal Workshop Orders only 68 or 23.61% complied fully with the process model from Figure 1.

4. DISCUSSION

The non-compliance of the order of 76,39% to the modelled process was a surprise, but illustrates perfectly that process modelling often imposes obstacles and constraints in real life situation. It shows why BPM is so demanding and why the adoption is not more swift. Further research revealed that the step marked S1 in Figure 1 (supervisor issuing a Request to open IWO) is often skipped and is done after the fact, after the IWO is closed and should be validated for invoicing. The supervisor's job is of such nature that he is seldom sitting behind his desk. When the operator / driver comes to get the Request, he is often left waiting for the supervisor to arrive. Each authorized supervisor has his own block of numbered Requests, which are used not only to start an IWO, but also to request provisions and service from other business units, so Request Blocks are not shared. In this situation, the driver / operator goes directly to the Workshop foreman. The Forman either knows the asset and is pretty sure that it is not an unknown vehicle or checks by phone with the head of the source business unit and opens a new IWO. From there on, the rest of the process model is followed consistently. When the order is completed, the Foreman gathers the documentation of all orders completed that day and, at predetermined time, meets with the supervisor (at the step marked S2 in Figure 1) at which point any missing Requests are filled and documentation completed. Although the process model is quite correct, and the Request should precede the opening of the IWO, in practice such sequence of events generates delays and process disruptions.

The monitoring process should be flexible enough to detect new patterns in process behaviour and recommend alternatives or possibly self-tune the model. This paper proposes such a solution based on modified model of Multidimensional Preemptive Coordination. The model was first described by Bacun (2013) and its extension to include participants external to the enterprise (Bacun, 2014). In the next sections, the model is briefly described, then model attributes that support monitoring of business processes even without existent model and lastly implications and level of self-tuning independence is discussed.

4.1. Multidimensional Preemptive Coordination

Multidimensional Preemptive Coordination is problem oriented corporate communications and alert infrastructure based on social networking principles. A group of professionals from different corporate business units gather on a closed corporate social network in an attempt to solve or monitor a business problem. Additional professionals might be invited into the discussion at different times and they post to the Topic News Wall at the altitude they were invited in. A topic is initiated by a Request For Action (RFA). Topic owner sets the deadline by which the problem has to be resolved. The authority to declare the topic as closed lies with the topic owner and that gives the information about the actual duration of the topic. The participants' upper management is invited into the topic by default which renders both horizontal and vertical transparency. Data overload is avoided with modifiable horizon of visibility that each participant can tailor to his own needs. At any corporate altitude, the upper management might declare topic visibility mandatory which overrides visibility settings at the lower levels.

Business processes are not constrained to a single business unit and interdepartmental transparency is one of the major issues in BPM implementation. The model of Multidimensional Preemptive Coordination is problem oriented and is insensitive to closeness of a single business unit. The organizational breakdown structure of a single business unit is still observed, and managers at a higher level can still argue the topic, but such interventions are logged in topic history and are transparent to the participants at the same altitude, which increases overall corporate accountability. But this has an important side effect. When such intervention is initiated, all the participants at the same altitude are alerted of a new condition. The alert propagation is governed by the particular topic's horizon of visibility and not by organizational breakdown structure so different business units will be alerted simultaneously at the proper altitudes. The system keeps track whether a post has been examined by a participant so uninformed participants can receive further notification.

In the business process modelling environment, a Request For Action is to be regarded as a task, one simple BPM element, a business problem that need to be solved. In fact, real business situations imply such sequence of events. In the process described in Figure 1, the Supervisor actually issues a numbered document that is called Request and is supposed to initiate a creation of an internal workshop order. The workshop foreman requests an introductory inspection of the asset to assert further actions.

A RFA has at least two participants: the Sender, who owns the topic, and the Recipient, responsible for work necessary for successful task completion. This implies that there is an implicit direction of the task, from Sender to the Recipient. The request has two distinct parts: a Heading, where task particularities are defined, and a History log, where progress is reported and options argued. The Heading contains request description, the deadline or planned duration and a status. The description and deadline are owned by the Sender and the Recipient cannot change them, while the status can be changed by any participant, signaling others of changed conditions. Only the Sender can declare the RFA resolved, implicitly defining its actual duration. The Sender may invite more participants as observers from any business unit and any corporate altitude, so that they may be able to post comments in the History log and participate in task resolution and progress. They become participants of a closed group of professionals gathered around a business problem and they are simultaneously alerted of new condition posted by any of them. This History log is timestamped and protected from change maintaining an audit trail of the discussion and actions taken. It becomes and effective billboard where selected professionals face problem resolution. The system logs status changes and may post system messages when predetermined conditions, like deadline approaching, are met.

Multiple requests can be chained into a sequence of process tasks creating a thread of events that spans multiple business units. A participant may need assistance from another professional or business unit in which case he would initiate another RFA. In the process model from Figure 1, after initial inspection, the foreman has to decide whether to engage external repair shop if the repair cannot be done internally. In that case he would need to issue a real document named Request to the Procurement Department to order the repair from one of the partners. Alternatively, he would order one or multiple mechanics to do the necessary repairs. In BPM technology we would say that he issued another RFA to his subordinates. In real life both situations can coexist simultaneously. There may be repairs that can be done internally, but particular spare part, or services, might be needed from external sources to repair the asset. This is a fork in a process model, and it is important to recognize the horizon of visibility of each fork. The mechanics who are doing the repair do not need to know who is the employee who handles orders to external partners, the foreman does. The Procurement Department does not need to see particularities that the mechanics are doing daily. However, in the Procurement Department, the received RFA might be routed to a particular employee who will select the partner to perform the external service. This partner might be constrained by Accounting for his financial obligations and payment might be restricted. If such condition implies delay in ordered spare parts or service, this information might be lost in bureaucratic labyrinths. As the workshop foreman initiated original RFA, he would be automatically notified of such development as he owns the thread and is a participant through the thread depth. The new status would be propagated both horizontally in Procurement Department and Accounting and vertically by organizational breakdown structure in both departments. It would further be propagated through the thread, across the departments, ultimately reaching both the workshop foreman and the Supervisor that started the thread, or the business unit that initiated the request to repair the asset.

Tailored views into presented data, personalized for each participant, focus his or hers attention to processes in the relevant scope of visibility and avoid data overload. Each employee can receive and initiate multiple requests. He may be participant of other request threads where he is an observer. His Personal News Wall shows just the posts from RFAs he participates in. At that, he may be invited at different altitudes in each thread. His Personal News Wall will, by default, show only the first depth level of each thread unless upper management declared a particular thread mandatory, in which case the posts from that thread will show compulsory. He can further tailor the Personalized News Wall by selecting date range, participant or particular thread. If a thread is not visible in the selected view, he will still be notified of its status change so he can react if necessary.

4.2. Business Process Monitoring

Linked Requests For Action form an ordered sequence of tasks that define a business process. Each task has a source, the Sender, and a destination, the Recipient. The Sender and Recipient may come from different business units.

Each request has a deadline or duration. The sum of thread durations define the planned duration of the process. Participants record worked hours in the History log. The sum of recorded work hours across the chain of request gives the actual duration of the process.

There is one task in any business process that is the central point of the process, the one that gives the whole process a meaning. In the process described in Figure 1. that is the creation of the Internal Workshop Order. There is a sequence of chained tasks that precede the main task and a sequence that follows. There is always a direction of events that create the IWO and thus define the whole process. Each task is performed by a particular altitude position in the Organizational Breakdown Structure of the corporation. Regardless of who is the actual professional that performs the task, his organizational position reveals the default performer.

We can recognize a business process if we analyse a sequence of RFAs. We can detect a group of RFA that repeat frequently because we have the information of direction, a sequence of events. One Supervisor Request initiates a particular IWO. Another request will instantiate a different IWO. The direction of RFA flow indicates that we have two instances of the same type, the same process and we can apply directed graphs theory. If we recognize the main task we can analyse the chain in both directions, preceding RFAs and following RFAs, and easily discover forks in the process.

The analysis of chained RFAs reveal the default participants. In a business process each Sender and each Recipient belong to a particular organizational unit. The model of Multidimensional Preemptive Coordination recognizes the Organizational Breakdown Structure and participants position in it. Once we recognize which task form a business process, we will know which organizational units will be touched and at which altitude, which leaves interesting possibilities in planning. If a particular task needs additional professionals to be invited as observers, we can easily plan replacements from the same business unit. From RFA History logs we know the frequency of each observer participation in a particular RFA. If an observer was invited only once in 10 instances of a particular task, we may decide to ignore it. Once the starting event is triggered, we know not only the sequence that follows, but also average time it will take, average workforce cost and participants that will need to be invited at a particular time.

The model of Multidimensional Preemptive Coordination solves one of the main challenges of BPM, namely long and complex model development. Enterprises engage teams that analyse and model processes in a number of inteviews with the staff. This effort proved to be quite lengthy because team members tend to be employees from IT provenience which have to learn business processes and extract knowledge from the participants. But the processes, optimized or not, are performed actively today and pertinent documents are issued. When an operator comes with a defect, the Supervisor actually writes a paper (it doesn’t matter whether he does it by hand or computer) that is named Request No X, and tells the operator to go with that paper to a particular employee, in this case workshop foreman, for further action. The foreman will create a paper called Internal Work Order where the sequence of actions will be recorded so that an internal invoice can be issued later. From the BMP point of view, those papers are the same, although their graphical representation and content are different. They have a Sender, a Recipient and a History log. The only thing that is missing is a timestamp and direction capture. We know that the Supervisor is the Sender, because he issued the Request, we only need to capture who should react to the Request, which is the information that the model of Multidimensional Preemptive Coordination captures.

4.3. Self-tuning Process Model

Business process recognition opens possibilities of self-tuning. Once the data of the process is captured analysis is the next logical step. Logging hours worked on particular task will give the total hours per task and the process. This is not extra work for the employees as this information is logged today, as it is basis for weekly or monthly time sheets. The only difference is that time sheets contain both effective and waiting hours, the hours spent in the enterprise. The distinction between effective and waiting hours is meticulously recorded in a number of productive environments, like manufacturing plants. It is mandatory that every driver and every machine operator logs working and waiting hours because maintenance depend strongly on that data. The hours worked per task will have a mean distribution which will suggest optimistic, pessimistic and most likely duration. If the values diverge from the expected values task status can be automatically upgraded and particular participants alerted. Bacun (Apr 2016) described a model of automated risk trigger status change detection based on data collected by Multidimensional Preemptive Coordination. A set of threshold values are attached to each task that update different task statuses when reached in a repetitive evaluation process. Similar principles were use to detect cost trending in construction project schedule activities based on ratio of effective resource consumption against planned quantities of the resource (Bacun, Oct 2016). The ratio of task effective duration up to date compared with expected duration across all the tasks of the process might give insight into the process cost trending.

Self-tuning should be considered as a periodical activity. It is safe to assume that each process would impose different evaluation periods. When divergence from established routes are detected, corrections can be taken. The results section of this paper shows not only the divergence from the process model in Figure 1, but also alternative solution. Although the Request should precede the IWO creation, business practice forces the personnel to adopt a different process route (issue the Request at step S2). If this reality is non-damaging, the evaluation routine could modify the model by introducing a decision stage, a getaway, before step S1. If the Supervisor is reachable then obtain a Request, if not, proceed to Workshop Foreman. Each task has a set thresholds defined that would trigger possible modification of the process. The process owner should decide what percentage of divergences should candidate the process revision. Had there been just 3 occasion when step S1 was skipped, we would not change the process, but 30 divergences make 10% of all process performances, so it might be significant. The 76.39% suggest that the model is not in accordance with reality, which is one of the most important challenges reported during BPM implementation.

There need be a Referee that would decide whether the process needs to be updated, whether the divergence actually is not damaging. Accepting automatic self-modification of the process might lead to cementing bad practice. After a divergence threshold is reached, the process owner should be notified and presented with alternative routes. Accepting the suggestion initiates the change of process model defaults. Process owner periodic evaluation is a periodic obligation as comparison of default work hours against realized hours will give insight about process bottlenecks and opportunities to improve.

A business process is seldom isolated, it is usually a chain in a larger process. The preventive maintenance process represents a significant financial burden to the enterprise. The regular maintenance of an asset requires the same process as defect detection does. The trigger is just different. The preventive maintenance is triggered by reaching the prescribed number of work hours, or predetermined number of miles driven. The scheduled maintenance have a serious impact on asset availability and hence project supply chain process and transportation process. Process interdependencies can be analysed once BPM data is collected, but data collection has to be blended with everyday business activities so that employees do not feel estranged. The model of Multidimensional Preemptive coordination provides unobtrusive data collecting that introduces self-tuning process modelling opportunities prior to the formal model definition. It presents how the process works at the moment and suggests alternatives resulted from everyday business workflow.

5. CONCLUSIONS

This paper proposes a business process monitoring infrastructure, blended with everyday business activities, that enables model recognition prior than formal model definition, logs alternative routes and lays foundation for refereed self-tuning procedures.

The adoption of BPM has been tenuous despite undisputed economic pressure and undeniable benefits. The process design is challenged by the lack of modelling data and insufficient process detail knowledge. The process programming on the other hand shows frequent program code changes which introduces delays in adoption. The proposed model of Multidimensional Preemptive Coordination confronts successfully both challenges. Process model is easily extracted from the captured data, alternatives disclosed and self-tuning capabilities enabled under referee supervision.

The model captures the direction of process activities as both the Sender and the Recipient are known. The presence of Observers is also logged. Hours worked reveal the performance of each task and overall process. The user login procedure establishes his position in the Organization Breakdown structure which positions the participants in the corporate arena. These elements are enough to recognize different instances of the same process and hence analyse process compliance and possible alternative routes. Set threshold values of diverged instances trigger self-tuning recommendations.

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